Cook, R., & Calkins, S. (2013). More than recall and opinion: Using "clickers" to promote complex thinking. *Journal on Excellence in College Teaching,* 24(2), 51-76.

More Than Recall and Opinion: Using "Clickers" to Promote Complex Thinking

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The authors focused on how a personalized response system ("clickers") could be used to promote more complex thinking in two sections of an intermediate college-level Spanish class. Using Bloom's Revised Taxonomy (2001), they designed questions to go beyond Bloom's lower-order thinking levels (recalling, understanding, and applying) to the higher-order levels (analyzing, evaluating, and creating). During the study, the authors alternated between using clickers and not using clickers, comparing how students performed on various common assessments. They found that students performed slightly better on assessments related to content that had been taught using clickers. More significantly, students engaged more fully in class, talked through complex questions, and explored cultural issues more readily when prompted by clickers.

Over the last few years, instructors across a range of disciplines have increasingly sought to engage with their students using such technologies as personalized response systems ("clickers") in the classroom. Clickers have been used in such diverse learning contexts as biomedical engineering (Roselli & Brophy, 2002), economics (Elliot, 2003), foreign language (Bruff, 2009), history (Cole, 2010), math (Bode, Drane, Ben-David Kolikant, & Schuller, 2009; d'Inverno, Davis, & White, 2003), philosophy (Immerwahr, 2009), physics (Bransford, Brophy, & Williams, 2000; Mazur, 1997), psychology (Mayer et al., 2009), and statistics (Wit, 2003). However, we have found in our respective roles as instructor (first author Cook) and

faculty developer (second author Calkins) that many instructors find it challenging to create clicker questions that sufficiently elevate the thinking of their students. Many instructors, though well intentioned, use clickers at a fairly low level, often relying on simple recall and knowledge questions or quick polls to gauge opinions rather than designing questions that elicit more complex thinking. Research has long suggested that when students engage meaningfully with their instructors, their peers, and the material—through reflection (Kolb, 1984), collaboration, and inquiry (Bain, 2004)—there are many positive benefits, including increased retention of material, improved performance, enhanced critical thinking, and a positive attitude toward education and learning (Astin, 1996; Pascarella & Terenzini, 2005).

This study focused on how a personalized response system (clickers) could be used to promote more complex thinking in two sections of an intermediate college-level Spanish class. Using Bloom's (2001) revised taxonomy, we designed questions to go beyond Bloom's lower-order thinking levels (recalling, understanding, and applying) to higher-order levels (analyzing, evaluating and creating). While the efficacy of clickers has been debated (Lasry, 2008; Morling, McAuliffe, Cohen, & DiLorenzo, 2008), preliminary research suggests that when clickers are used to do more than take attendance or administer quizzes, they can promote active learning (Kolikant, McKenna, & Yalvac, 2005), student engagement (d'Inverno et al., 2003), improve student performance (Yourstone, Kraye, & Albaum, 2008) and critical thinking (Bode et al., 2009), especially when questions are designed using a taxonomy, such as Bloom's revised taxonomy, to encourage higher-order thinking (Bruff, 2009).

Because clickers can readily gauge student knowledge, comprehension, opinions, and confidence, they can provide useful feedback to both instructor and students about their learning in the class. Moreover, because clickers can also be used in pairs or in groups, they may enhance collaborative learning (Barrett, Bornsen, Erickson, Markey, & Spiering, 2005; Mazur, 1997) and foster a positive environment in which students are open to making mistakes (Boyle & Nicol, 2003; Draper, Cargill, & Cutts, 2002).

Methods

Study Context

We conducted this study in an intermediate Spanish course taught by the first author at a private research-intensive university located in the Midwest. Students at this university tend to be hard working,

competitive, and high achieving, and retention and graduation rates are very high. Students enrolled in the college of arts and sciences must complete a language requirement, which is equivalent to two years of college-level language instruction, fulfilled through Advanced Placement (AP) scores, department testing, or prior coursework. The college offers courses in many different languages, with Spanish being one of the most popular options. Approximately 750 students take Spanish to complete their language requirement, with many also opting to study abroad in a Spanish-speaking country.

This study focused on two sections of an intermediate Spanish course (section A and section B) taught over a 10-week quarter. Each section met three times a week in 50-minute sessions. Students also had to participate in an online video lab held outside of class two or three times a week. The course is intended for non-Spanish majors, and it fulfills a distribution requirement in the university's school of arts and sciences. The course is based on the communicative method, emphasizing vocabulary building, listening comprehension, speaking, and learning grammar through context. While there is a shared curriculum predetermined by a faculty committee, individual faculty members can adapt the curriculum somewhat to meet their objectives. In terms of learning objectives, the first author wanted her students to (1) apply previously learned and new concepts in vocabulary and grammar and evaluate their usage in different contexts, (2) build necessary communication skills required for the next course level, and (3) analyze texts to develop a deeper understanding and appreciation of Hispanic culture.

In each section, students were required to take two major timed, in-class exams (a midterm and final) lasting 50 minutes each (18% for the midterm exam and 22% for the final exam, respectively) focusing on readings, grammar, and vocabulary from the textbook. The exams were not cumulative. Students also were required to watch, outside of class, two complete movies divided into five episodes each. After each episode, they completed a 10-minute online quiz (10%). In the fourth and the ninth weeks, students made oral presentations of two and five minutes, respectively (10%) focusing on material and vocabulary from the textbook. After each chapter, students took short timed quizzes in class (10%). Students also had to complete two timed, written compositions lasting 30-50 minutes each (4% each). In addition, students had to turn in seven weekly paragraphs (5-6 sentences) about specific topics (for example, "my family members," "my favorite meal") (5%) and to complete workbook assignments (2%). Class participation and attendance also counted for 13% of the final grade.

Participants

After gaining IRB approval from our institution, we acquired consent from all 30 students enrolled in sections A and B. Students were informed that their responses would remain anonymous, and their grades would be reviewed only in aggregate at the end of the term. All students were undergraduates between 18-21 years of age (mostly first- and second-year students), and none had been taught by the instructor prior to this course. There were 15 students in each section, with 17 (56.66%) female and 13 (43.33%) male.

The two class sections varied in their composition and demeanor. Section A was held at 8:00 am and enrolled 15 students (9 men and 6 women), four of whom were seniors. There were no university athletes in the group. We, along with our research assistant (a graduate intern at the Teaching and Learning Center), independently agreed that the students in section A seemed more serious, preferred to work individually—usually waiting to be called on rather than volunteering—and rarely spoke to one another.

Section B was held at 11:00 am and enrolled 15 students (4 men and 11 women), none of whom were seniors. Unlike section A, 12 out of the 15 students were university athletes, many of whom seemed to know and interact with each other outside of class. The three of us all independently agreed that the students in section B seemed more outgoing, relaxed, and comfortable when interacting with each other during class. They also seemed to prefer working in pairs or small groups, readily answering questions posed by the instructor and one another.

Neither section served as a complete control; as we explain below, we alternated when we used clickers between the two sections. Our goal was to compare the effects of clickers within sections, rather than between sections.

Instruments

We used several methods to gauge the effectiveness of using clickers in the classroom.

Clicker Activities

We used clickers seven times throughout the term in each section. Each clicker activity was designed to help students grasp key course concepts and drew on Bloom's (2001) Revised Taxonomy—a means for classifying and ordering thinking skills in terms of increasing complexity and sophistication. Moving from lower-order thinking skills (remembering,

understanding, and applying) to higher-order thinking skills (analyzing, evaluating, and creating), the taxonomy differentiates the kinds of knowledge (factual, conceptual, procedural, and metacognitive) involved in learning (Anderson et al., 2001). Each question set was designed to help students gauge their recall of key vocabulary, apply their knowledge to new contexts, analyze and evaluate information, and create new sentences (examples of each question type are described more fully below). The higher-order questions subsume the lower-order skills. On three occasions, both sections received the same clicker questions, and on four occasions, clickers were used in only one section. On those occasions, an alternative but still interactive discussion method was used in the class not using clickers that day.

Classroom Observations

Our research assistant attended 5 sessions of each section to observe the use of clickers and, in cases where the clickers were not used, the non-clicker replacement activity. In both types of sessions, she observed levels of student engagement and interaction, teacher explanations, and points of discussion that arose from the clicker questions (particularly those that focused on cross-cultural understanding). In sessions that used clickers, she independently rated each clicker question, assessing each question for the level of thinking associated with Bloom's Taxonomy. In sessions that did not use clickers, she compared the extent to which the instructor used active-learning methods to foster the same student engagement.

Comparison of Aggregate Grades

When the term was completed, we compared, in aggregate, how students in each section performed on quiz and exam items related to the conceptual questions discussed during the clicker activities in order to see if there were any measurable difference between the groups. We did not look at student grades individually.

Focus Group

In the middle of the quarter, between the fourth and sixth weeks, the research assistant and the second author visited each section and conducted a 25-minute evaluation of the class without the first author (instructor) being present. We divided each section into small groups (2-3 students) and asked them to consider three questions about their assessment of the

class, focusing on their appraisal of the use of clickers in their learning. One of us then asked the students to share their responses and to come to a general consensus about strengths and weaknesses of the instructor and course, including factors were helping or hindering their learning. Afterward, we compiled the results and shared the feedback privately with the instructor.

End-of-Term Student Ratings

In standardized student ratings administered online at the end of the term, students were asked about their overall satisfaction with the course and about their perceptions of clickers on their learning.

Description of Clicker Activities and Questions

Before using clickers for the first time, the instructor informally gauged her students' experience with them. With the exception of a handful of science majors, she found that most students had not used clickers before. She explained to her students that her reasons for using clickers were to help them grasp key course concepts, enhance their learning, interact with the material, and promote cross-cultural understanding.

Across the 10 weeks of the term, the seven sets of activities focused on different topics, including comparisons of American and Latino-American stereotypes and descriptions of different communities, customs, and families (see Table 1). Within these topics, the instructor integrated grammar lessons, including the uses of the "to be" verbs *ser* and *estar*, the present, imperfect, and preterite tenses, the indicative and imperative modes, the reflexive verbs, and the pronouns of direct and indirect objects. Following the syllabus, she also included four cultural readings: *La Llorona* ["The Weeping Woman"], *La Tomatina de Buñol* ["The Tomato Festival of Buñol"], *El Nieto* ["The Grandson"], and *Contrastes Entre Culturas* ["Contrasts Among/Between Cultures"].

In total, the instructor created 101 separate clicker questions, averaging about 14 questions per clicker session. In all but one session (which focused on application), the instructor asked questions using several different levels of Bloom' revised taxonomy, trying to incorporate some lower-level questions (remembering, understanding, and applying) and some higher-level questions (analyzing, evaluating and creating). After the course was over, the two authors and the research assistant independently rated the level of each question. Although we disagreed initially on 35 items, we discussed each contested item until we achieved a consensus

Table 1
Comparison of Clicker and Non-Clicker Activities in Seven Classroom Sessions

	Topics	*Session w/ Clickers*	*Session w/o Clickers*	*Activity With Clickers*	*Activity Without Clickers*
1	Grammar: Direct and Indirect Objects	Both A and B	—	Instructor posed clicker questions at the applying (individual), analyzing (in pairs), and evaluating (in groups of 3) levels.	—
2	Reading: *La Llorona* ["The Weeping Woman"]	A	B	Instructor posed clicker questions at the remembering (individual), applying and analyzing (in pairs), and evaluating and creating (in groups of 3) levels.	Instructor posed questions at the remembering (individual), applying and analyzing (in pairs), and evaluating and creating (groups of 3) levels.
3	Customs and Traditions; Vocabulary	B	A	Instructor posed clicker questions at the remembering (individual), applying and analyzing (in pairs), and evaluating and creating (in groups of 3) levels. Class discussed differences in cultural traditions.	Instructor posed questions at the remembering (individually), applying and analyzing (in pairs), and evaluating and creating (in groups of 3) levels. Students created sentences. Class discussed differences in cultural traditions

Table 1 (*continued*)
Comparison of Clicker and Non-Clicker Activities in Seven Classroom Sessions

	Topics	*Session w/ Clickers*	*Session w/o Clickers*	*Activity With Clickers*	*Activity Without Clickers*
4	Grammar: Preterite and Imperfect Tenses	Both A and B	—	Instructor posed clicker questions at the applying level. The goal was to help students understand the difference in the two past tenses.	—
5	Reading: *La Tomatina de Buñol* ["The Buñol Tomato Festival"]	A	B	Students compared the event in the reading with other similar events in the United States. Students viewed an 8 minutes video to show how the Spanish celebrate *La Tomatina de Buñol.* Instructor posed questions at the remembering, analyzing, and evaluating levels.	Students compared answers to questions from their books (in pairs). Students compared the event in the reading to similar events in the United States. Students viewed an 8-minute video to show how the Spanish celebrate *La Tomatina de Buñol* and posed questions at the analyzing and evaluating levels.

6	Reading: *El Nieto* ["The Grandson"]	B	A	Instructor posed clicker questions at the remembering (individual), applying and analyzing (in pairs), and creating (in groups of 3) levels. The goal was to learn if students read the story, knew the use of the imperative mood in Spanish, and were able to rebuild the story based on pictures posted by the instructor.	Instructor posed remembering questions (individually) about the story and applying and analyzing questions (in pairs) focusing on the imperative mood. In groups of 3, students had to rebuild the story based on pictures posted by the instructor.
7	Review for the Final Exam	Both A and B	—	Instructor posed clicker questions at all levels: remembering (individual), applying and analyzing (in pairs), and evaluating and creating (in groups of 3 and 4). As this was the last class before the final exam, the questions were designed to help students review material.	—

about the level of each question. We classified 29 questions (28.71%) as *remembering*, 9 (8.91%) as *understanding*, 44 (43.56%) as *applying*, 2 (1.98%) as *analyzing*, and 14 (13.68%) as *evaluating*. We classified 1 question (.99%) as both understanding and applying, and another 2 questions (1.98%) as both analyzing and evaluating. In addition, six questions (5.58%) asked mainly at the evaluating level focused specifically on promoting cross-cultural understanding. We describe each question type below (all questions had multiple-choice responses for students to choose from).

A question focused on *remembering* simply requires a student to recall or recognize facts or basic knowledge. We designed *remembering* questions to gauge whether students had read the short story. There is either a right or wrong answer, with little room for discussion. Arguably, some students who didn't do the reading might be able to guess correctly, while some who did do the reading might accidentally select the incorrect answer, but generally these questions offer an effective means to assess at a basic level whether students completed the required work.

At the second level of Bloom's revised taxonomy, *understanding*, the questions focus on students being able to show a knowledge of basic ideas or concepts. In *understanding* questions, students must show they comprehend basic vocabulary. They are, however, being asked to move one step beyond basic recall, because they must understand the definition and then reflect on its synonym or an antonym. Students are, thus, being asked to demonstrate comprehension rather than simple memorization.

We designed the questions at the third level of Bloom's revised taxonomy, *application*, to help students apply concepts, vocabulary, and grammar to a new context—for example, whether they can substitute the direct and indirect object with a pronoun or to demonstrate the application of a commonly used verb. To answer these questions, students needed to remember the vocabulary, understand how the grammar is used, and be able to apply their understanding of the grammar appropriately.

Bloom's next three levels—*analyzing*, *evaluating*, and *creating*—all are designed to elicit higher-order thinking. They are not meant to be viewed hierarchically, and are often complementary. Thus, *analyzing* questions require students to analyze different parts of the text rather than simply to read and comprehend the text. Students need to break down the information they received from the text (a reading or a movie, in these cases) and identify the reason or motive for reaching their conclusion. For example, students were asked what sort of event the Tomato Festival is. While such a question may seem to at the level of simple recall or comprehension, in this case, students had not been informed beforehand what type of event the Tomato Festival was. Instead, they had to glean evidence about the

festival from what the video and the reading, and determine whether it was primarily historical, cultural, or religious in nature.

Like *analyzing*, Bloom's next two levels—*evaluating* and *creating*—are considered higher-order thinking. With *evaluating* questions, students are asked to assess critically different ideas and concepts, using evidence to support their judgments. *Evaluating* questions are very similar to the *analyzing* questions described above, but they tend to have students appraise more subjective character motivations and behavior. For example, we showed students pictures of Leticia, a character from a movie, before asking what she was thinking at that moment. Students would then have to make inferences about what they saw in the picture based on their larger understanding of the text. In this case, students cannot simply recall information from the story because the author does not explain Leticia's thoughts outright. Students must evaluate the picture based on evidence found in the story.

Finally, *creating* questions would have allowed the instructor to help students all the elements they had learned (vocabulary, grammar, context) together and reorganize those elements to create a new story, or simply create a different ending. However, due to type of clicker technology we used (they lacked the capacity for written responses), we did not have the capacity to allow students to create an answer other than what the instructor provided. However, as we discuss more fully below, we did design questions that allowed students to engage at a creating level during the clicker sessions.

In addition to getting a specific level of thinking, the instructor also designed questions intended to promote cross-cultural understanding. For example, she asked,

> ¿*Qué opinan de la fiesta de La Tomatina*? ["What is your opinion about the La Tomatina party?"]

La Tomatina [the Tomato Festival] is an event that the people from Buñol, Spain, celebrate once a year where they throw 90,000 pounds of tomatoes at each other. The two answer choices, either "It is ridiculous" or "It is funny," were generated from how students in previous years had viewed the event. While past students had found the party funny, it was clear they did not understand why the people of Buñol engaged in what seemed to them a strange and nonsensical act. This time, after students responded to the initial clicker question, the instructor then gave them the opportunity to compare this event with similar events from their own cultural traditions to improve their understanding across cultures. The purpose of this follow-up question was not just for students to answer "yes" or

"no," but also to encourage them to explain their answer. After seeing the clicker response results, the instructor explained the ways in which many Mexicans "remember" or honor their deceased relatives and ancestors, and how other Latin Americans observe the anniversary of their relatives' deaths. At the end of the comparison, the instructor had students explain how they observed the anniversary of their relatives' deaths. Students worked in groups of three to discuss this topic.

Comparison of Clicker and Non-Clicker Activities

When teaching the same material without clickers, the instructor used a range of active-learning techniques (for example, discussion, think-pair-share, small-group work, portable dry erase boards, visual aids for narrative writing) to stimulate the same type of engagement and cross-cultural understanding as she did when using clickers. Table 1 illustrates the comparison between all seven clicker and non-clicker activities. For example, after the students read the story *La Llorona*, students in section A used clickers to discuss the text, while students in section B did not. As much as possible, the instructor tried to employ the same kinds of questions and activities in both clicker and non-clicker activities. While the instructor occasionally posed the questions slightly differently (when speaking, she used a slightly more conversational style), she used the same remembering and evaluating questions in each session. On another occasion, the instructor used a multiple-choice "pop quiz" in section A (no clickers) to assess their reading of *El Nieto*. Identical questions were posed as clicker questions to section B. In both cases, the students answered individually, and their answers were graded.

While we did expect all students to participate during clicker activities as well as on individual graded quizzes, we recognize that students might choose not to participate in non-clicker activities, especially those where they were not being graded or otherwise held accountable for their participation (Svinicki & McKeachie, 2010). In our observations, we took careful note of when students seemed more and less engaged. Generally, we evaluated how the students answered the questions, how they responded to the revealed answers (clicker activities only), how they engaged with one another, and how they engaged with the material.

Findings

Comparison of Responses for Lower- and Higher-Order Thinking Questions

As Table 2 indicates, the instructor required answers for 94 of 101 questions. Certain questions, such as those at the *evaluating* level, did not have a single correct answer. Most of the lower-level questions were answered individually, whereas students were asked most of the higher-level questions while working in pairs or groups. Students did not always get the answer correct when using clickers, performing the least well at the *analyzing* (50%) and *understanding* (55.5%) levels. On any question missed by more than 30% of the class, the instructor would probe incorrect responses so that students could question and challenge each other (Bruff, 2009; Mazur, 1997). Students did tend to do well on the *applying* (72.72%) and *evaluating* (71.42%) questions.

Comparison of Questions Focusing on Promoting Cross-Cultural Understanding

The six questions that focused on promoting cross-cultural understanding did not have a "correct" answer, but from their answers, students were able to probe one another's ideas. For the question about *La Tomatina* discussed above, for example, while all of the students (100%) initially viewed the festival as "funny," after discussing the origins and history, they came to understand more about the deep cultural roots underscoring it.

Comparison of Student Assessments Between Sections

Comparing how students performed on quizzes revealed that students generally performed slightly better on quizzes when they had used clickers to engage with the material, but not to a statistically significant degree (see Table 3). Only on the fourth quiz did students who had used clickers perform less well. This quiz also contained sections unrelated to the discussion of *La Llorona* (the focus of the clicker questions), and, as such, we cannot explain the difference in average scores—other than that students sometimes perform better on some assessments than others.

We found, too, that students in both sections performed similarly well on the midterm, in areas related to what they learned using clickers. Out of 77 possible points, on average, students in section A earned 66.96 points, while students in section B earned 65.92 points (see Table 4). Similarly, as Table 5 indicates, out of a possible 75 points on the final exam, students

Table 2
Percentage of Questions Correct at Each Level

Bloom's Taxonomy Question Levels	*Number of Questions Asked at Each Level*	*Percent of Total Questions Asked at Each Level*	*Number of Questions Answered Correctly at Each Level***	*Percent Correct*
Remembering	29	28.71%	17 (n = 29)	58.62%
Understanding	9	8.91%	5 (n = 9)	55.55%
Understanding / Applying*	1	0.99%	1 (n = 1)	100.00%
Applying	44	43.56%	32 (n = 44)	72.72%
Analyzing	2	1.98%	1 (n = 2)	50.00%
Analyzing / Evaluating*	2	1.98%	1 (n = 2)	50.00%
Evaluating**	14	13.68%	5 (n = 7)	71.42%
Totals	101	100%	65 (n = 94)	64.35%

Note. *We decided that these questions could be classified at two levels.
**Some questions did not ask for one single correct answer, so those were also not included in these results.

Table 3
Comparison of Student Performance on Quizzes Related to Topics Covered by Clickers

Assessment	*Focus*	*Total Points*	*Section A (average correct)*	*Section B (average correct)*
Quiz 1	Vocabulary and video episode	10	8.65 (clickers)	7.75 (clickers)
Quiz 2	Grammar: Verbs *ser* and *estar* ["to be" verbs]; present tense and pronoun (direct and indirect object)	10	9.47 (no clickers)	9.25 (no clickers)
Quiz 3	Vocabulary and video episode	10	8.19 (clickers)	8.28 (clickers)
Quiz 4	Cultural reading: *La Llorona* ["The Weeping Woman"] Grammar: Verbs *ser* and *estar* ["to be" verbs]; present tense	10	6.53 (clickers)	7.58 (no clickers)

Table 3 (*continued*)
Comparison of Student Performance on Quizzes Related to Topics Covered by Clickers

Assessment	*Focus*	*Total Points*	*Section A (average correct)*	*Section B (average correct)*
Quiz 5	Vocabulary and video episode; Grammar: *Gustar* ["to be pleasing to"] and past tense (preterite and imperfect)	10	8.75 (no clickers)	8.93 (clickers)
Quiz 6	Reading and grammar: past tense (preterite and imperfect)	10	8.90 (clickers)	8.30 (no clickers)
Quiz 7	Grammar: Commands (formal and informal)	10	7.07 (clickers)	6.54 (no clickers)

Table 4
Comparison of Student Performance on Midterm Sections Related to Topics Discussed Using Clickers (77/100 pts.)

Focus	*Total Points*	*Section A (average correct)*	*Section B (average correct)*
Vocabulary	18	14.76	14.57
Grammar: Contrast verbs *ser* and *estar* ["to be" verbs]	10	8.17	8.02
Textbook (Chapters 1 and 2)	12	11.21	10.99
Grammar: Present tense; reflexive verbs	12	10.87	10.67
Grammar: Direct and Indirect object pronouns; double object pronouns	8	7.17	7.02
Reading: *Contrastes entre Culturas* ["Contrasts among cultures"]	5	4.00	4.06
Reading: *La Llorona* ["The Weeping Woman"]	5	4.71	4.73
Video	7	6.07	5.86
Total	77	66.96	65.92

in section A averaged 53.23 points, while students in section B averaged 52.45 points. Overall, students performed similarly in both classes, earning final grades that averaged 86.71% (section A) and 86.77% (section B) (see Table 5).

Evaluation of the Course

We used several methods to evaluate the clicker activities during the quarter. These methods included informal feedback from students

Table 5
Comparison of Student Performance on Final Exam Sections Related to Topics Discussed Using Clickers (75/100 pts.)

Focus	*Total Points*	*Section A (average correct)*	*Section B (average correct)*
Vocabulary; Verb: *gustar* ["to be pleasing to"]	28	20.93	23.17
Grammar: Preterite and Imperfect	16	12.60	12.03
Grammar: Commands (formal and informal)	16	9.1	7.23
Video	5	3.60	2.92
Review Grammar: Verbs *ser* and *estar* ["to be" verbs]; present tense; reflexive verbs; reading *El Nieto* ["The Grandson"]	10	7.00	7.10
Total	75	53.23	52.45

throughout the quarter, a small group analysis (SGA) conducted at the middle of the term, observations by a trained observer, and end-of-term student ratings.

Informal Feedback

Through informal conversations with students, the instructor was able to gauge their immediate responses to the different classroom activities employed, including the clickers. For example, simply by polling students verbally at the beginning of the quarter she was able to discover their previous experience with clickers and, throughout the quarter, their general attitudes toward clickers. During the clicker activities, students were very comfortable letting the instructor know when they thought her questions were "tricky" (for instance, uses of the verb *gustar* ["to like"] or preterite/imperfect questions), or hard to understand. Informally, they regularly voiced enthusiasm when presented with the clickers, and they often asked when they could use the clickers again.

Small-Group Analysis (SGA)

In focus group fashion, we asked the students in the class several questions about what was enhancing or impeding their learning in the course. We asked each section to generate the three most important aspects that enhanced their learning and the three most important aspects that could be improved. Each student then independently rated the extent to which they agreed with the aspect generated by the class on a Likert-style scale from 1 (*do not agree*) to 9 (*strongly agree*) to negate the impact of more dominant student voices. Regarding what enhanced their learning, in section A, all of the students in attendance ($n = 13$) agreed that the instructor was encouraging and positive (100%). They also mostly agreed that discussing videos in class was helpful (61% agreed; 31% were neutral; 8% disagreed). Although there were two separate questions focusing on clickers, 6 students (46%) also identified the use of clickers as helpful, 4 (31%) were neutral, and 3 (23%) disagreed. In section B, as a group ($n = 12$) the students all agreed (100%) that the instructor had created a positive and encouraging atmosphere that helped them learn. They also identified the use of clickers as one of the most helpful aspects of the class, with 11 students (92%) in agreement and 1 student as neutral. They found the instructor's feedback on assignments to be helpful ($n = 11$; 81% agreed; 19% were neutral), as they did as her providing PowerPoint slides ($n = 12$; 75% agreed; 25% were neutral).

In response to the second question about possible improvements, students in section A identified four aspects that could be improved, with none relating specifically to clickers. They focused on the importance of the instructor following the syllabus (77% agreed this would help), posting assignments on the course management system (38% agreed), not rescheduling classes on Sundays (46% agreed), and providing more clarity about grades (38%). Students in section B had to be prompted to find areas to improve, and they identified only one additional area. They thought it would be helpful to go over videos in class more often ($n = 12$; 83% agreed; 8% were neutral; 8% disagreed).

We asked students specifically to rate the extent to which clickers improved their understanding of course material and concepts. We found that in section A ($n = 13$), 8 students (62%) agreed, 3 (23%) were neutral, and 2 (15%) disagreed. In section B ($n = 12$), 10 students (83%) agreed, and 2 (17%) were neutral. We also asked students to rate the extent that they perceived clickers to be improving their understanding of Spanish culture. In section A, nearly half the class agreed (6 students; 46%), 2 (15%) were neutral, while 5 (38%) disagreed. In section B, 5 students (42%) agreed, 6 (50%) were neutral, and only 1 (8%) disagreed.

Classroom Observations

Throughout the five observations of each class, we found that clickers seemed to engage the students more effectively and make them more enthusiastic about the material, regardless of whether they answered the questions correctly. When clickers were being used, the observer noted that students appeared to doodle less, stay on task more readily, and display fewer signs of sleepiness. This increased engagement and energy was particularly notable in section B, which tended to be more energetic overall. Section B students—80% of whom were university athletes—particularly seemed to enjoy creating a competitive environment when answering questions using clickers in groups. Also, when asked a more challenging clicker question, students were more likely to consult fellow classmates for assistance than when challenging non-clicker questions were asked. Our observer also noticed that the male students in both sections were more likely to contribute to class discussions during lectures involving clickers than they were without the clickers. Students who tended to be quieter also were more likely to explain their answers aloud when clickers were used.

End-of-Term Student Ratings

We asked the students several questions about clickers on the standard end-of-term student ratings administered by the university. We asked two questions about using clickers in class: (1) "Did using clickers improve your understanding of Spanish-speaking cultures?" and (2) "Did using clickers improve your understanding of course material and concepts in this class?" The university uses a fixed Likert scale in which 6 is "high" (generally understood to indicate stronger performance), and 1 is "low" (generally understood to be weaker performance). In response to the first question, 14 of 15 (93.33%) of students in section A gave a cumulative ranking of 3.79 (out of 6.00), while 13 of 15 (86.67%) of students in section B scored the clickers' effectiveness even higher (4.83 out of 6.00). In response to the second question, 14 of 15 students in section A rated the clickers' effectiveness at 4.00 (out of 6.00), while 13 of 15 students in section B rated them at 5.08 (out of 6.00). Students' qualitative comments about the clickers were generally favorable, with statements like, "I enjoyed the combination of in-class clickers, group assignments, homework, and quizzes," and "The clickers were good, and the professor was very responsive to the students." One student (from Section A) did note the following: "I didn't like using clickers. I didn't really get much out of it,

and it just seemed like a waste of time to me. Other than that, I very much enjoyed the class!"

Critical Reflections

We found that using Bloom's Revised Taxonomy to frame clicker questions helped engage students in the process of learning a new language, capture their attention, and encourage them to participate more actively. In particular, we found that using clickers in class before a quiz or a major exam helped us to collect information about what our students understood and, even more importantly, gauge what they did not understand. This instant feedback from the entire class helped the instructor identify specific areas that needed to be reinforced in class. While our findings were not statistically significant, the data do support other studies suggesting that the process of using clickers promotes more active learning and engagement with the material (Boyle & Nicol, 2003). Certainly, as Lasry (2008) and Morling et al. (2008) might contend, an instructor can engage students without using clickers, but there is some indication that the anonymous process of sharing responses and discussing them "in-the-moment" was beneficial to retention, as suggested by students' performance on the quizzes.

The data also suggest that clickers helped engage students more and helped make learning new vocabulary and grammar more interesting and stimulating than did the standard study guide. Student feedback about clickers—garnered from the small-group analyses, the end-of-term student ratings, and informal conversations—was mostly positive, suggesting students found that the clickers supported (or at least were not detrimental to) their learning in the course. The observation data further suggested that students appeared more physically excited and engaged by higher-order thinking questions than by lower-order questions, especially those focusing on pure recall. This indicates to us how crucial it is that clickers not be used only for lower-order questions, or worse, simply for attendance checks.

In addition to what we learned from the data, we also gleaned some larger insights about the process of creating and implementing clicker activities. We share these broad insights next.

1. Developing Clicker Questions Can Be a Reflective Teaching Process.

The instructor discovered that using clickers—and Bloom's taxonomy more specifically—helped her to rethink both the kinds of questions she

was posing to her students and her methods for engaging students in more complex thinking. This reflection upholds other research that suggests that clickers can be catalyst for changing faculty attitudes towards teaching and learning (Kolikant, Drane, & Calkins, 2010).

2. Asking Clicker Questions at Different Levels Can Help Gauge Student Learning.

The clickers allowed us to assess student learning in the course and to gauge which aspects needed to be reinforced. For example, when the students found it difficult to employ the subjunctive, a concept notoriously difficult to teach, as Jelinski (1977) has noted, the instructor learned to take a different approach: reframing the questions, thus making the topic less difficult for students. Clickers can be helpful to both students and the instructor for instantly identifying their strengths and areas for improvement (Bruff, 2009).

3. Clicker Questions Should Be Evaluated Regularly for the Level of Thinking They Are Promoting.

As we explained above, when the three of us independently rated each of the instructor's questions, the two of us who were not teaching the course sometimes ascribed a higher-order thinking level to a question that the instructor had deliberately created as a warm-up lower-order thinking question. We found that on the surface, without context, some questions appeared to be evoking analysis or evaluation, when the instructor intended them to evoke remembering or understanding. Similarly, on a few occasions the instructor believed she was asking higher-order questions, but after discussing and reflecting on the questions, she agreed that some questions may unintentionally have been lower order in nature.

4. Clicker Questions Can Get at Creative Thinking.

Although we found it more challenging to create higher-order thinking questions, the instructor plans to develop more questions that will challenge students to think creatively as well as critically. For example, the instructor might post two or three pictures on the screen and ask students in groups to select one picture from which they could then create a new story or a new ending. For example, students might be asked, *Escriban un diálogo entre La Llorona y el hombre que ves en la imagen* ["Write a dialogue between La Llorona and the man you see in the picture"]. After working

together, each group would tell their story in Spanish. The instructor would assign each group a letter (A, B, C, D, or E). After each group presented their story, the whole class would then vote by letter choice which story they found the most interesting and creative. This type of question activity would give students the opportunity to incorporate the new vocabulary and grammar structures in a more engaging and authentic way.

5. Students Could Create Clicker Questions for Their Peers.

Students also could engage at Bloom's *creating* level if given the opportunity to create the questions themselves. When we piloted questions of this type, students were enthusiastic about coming up with their own questions and trying them out on their peers.

6. Students Can Evaluate One Another's Clicker Question Responses.

We found that letting students see how their peers answered a question had several benefits. As research on clickers has long indicated, students appreciated the anonymity that clickers provided so they didn't feel embarrassed about wrong answers, and they also knew that they were not alone when they made mistakes (Boyle & Nicol, 2003; Draper et al., 2002). Similarly, they did not feel as pressured to answer questions verbally in front of their peers. Students would also have the opportunity, with *creating* questions, occasionally to evaluate their peers' responses and give them feedback about the questions they had created.

7. Instructors May Need to Increase Response Time With Clicker Questions.

Finally, but not insignificantly, we learned that we need to think carefully about the amount of time that we give students to respond to each question, especially if we are asking a particularly difficult question or when they must work in pairs or groups. They may need more time than assumed to reflect and decide on an answer, particularly when questions and choices are lengthy and/or written in the target language.

Study Limitations and Conclusions

These critical reflections should be viewed in light of several limitations. First, the clickers we used were limited in their ability to let students create their own responses. If students had been able to generate their responses,

we could have offered *creating* questions to get at another level of Bloom's (2001) Revised Taxonomy. Second, we also recognize the two student cohorts were not as similar as we would have expected; although most were first- and second-year students, one section comprised mainly athletes and students who socialized outside of the class, while the other section did not seem to have the same familiarity or ease with one another. Different class dynamics may have impacted how the students responded to using clickers. This was why we focused our comparison within sections rather than between sections. Also, as we noted, the class sizes were small, as were the number of responses for some items. As such, the differences in scores were not statistically significant. If we had been to run the study in more sections we might have had more statistically significant—and perhaps more generalizable—findings.

Overall, despite these limitations, we found that using clickers in the class enhanced the instructor's ability to create higher-order questions and raised the level of student engagement with the material. When we got beyond simple recall and application questions, the students were able to develop their ability to employ vocabulary and concepts within new contexts. While clickers themselves may not transform teaching or learning, when the questions asked are carefully created and implemented, clickers have the potential to transform the learning environment.

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Acknowledgments

We wish to thank Ashley Schaefer for her assistance with conducting classroom observations and helping to classify questions.

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